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MÆLAND, Geir [NO/NO]; Bruflata 2, N-6600 Sunndalsøra (NO). STRØMSVÅG, Åge [NO/NO]; Einangveien 11 E, N-6600 Sunndalsøra (NO).

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(74) Agent: HOFSETH, Svein; Norsk Hydro ASA, N-0240 Oslo (NO).

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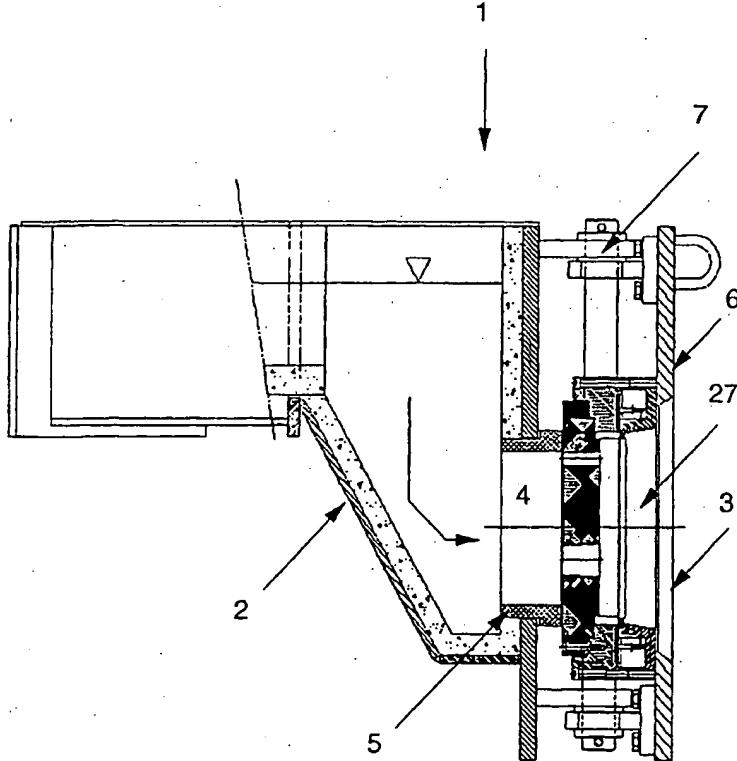
(71) Applicant (for all designated States except US): NORSK HYDRO ASA [NO/NO]; N-0240 Oslo (NO).

(72) Inventors; and

(75) Inventors/Applicants (for US only): JOHANSEN, Inge [NO/NO]; Håsenveien 35, N-6600 Sunndalsøra (NO).

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(54) Title: EQUIPMENT FOR CONTINUOUS, HORIZONTAL CASTING OF METAL



(57) Abstract: Equipment for continuous, horizontal casting of metal, in particular aluminum. The equipment including an insulated reservoir or pool (2), which is designed to contain liquid metal, and a mould (3), which can be removed from the pool (2), with an insulating plate (19) with holes (25, 26) which communicate with the mould, the mould (3) including a preferably circular cavity (17) with a wall (12, 13) of permeable material for the supply of oil and at least one annular slit or nozzles (16) arranged along the circumference of the cavity for the direct supply of coolant. In addition to the oil gas, is supplied through the permeable material (12, 13) and annuli (20) are arranged between the permeable wall material and the mould housing (8) to distribute the gas/oil to the wall material. The annuli (20) is divided into sectors using plugs or similar restrictions (21) and are supplied with oil/gas via separate supply channels (10, 11) for each sector, thus making it possible to differentiate the supply of oil/gas around the circumference.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

EQUIPMENT FOR CONTINUOUS, HORIZONTAL CASTING OF METAL.

The present invention concerns equipment for continuous, horizontal casting of metal, in particular aluminium, including an insulated reservoir or pool, which is designed to contain liquid metal, and a mould, which can be removed from the pool, with an insulating plate with holes which communicate with the mould. The mould includes a preferably circular cavity with wall material of permeable material, for example graphite, for the supply of oil and at least one tubular die arranged along the circumference of the cavity for the direct supply of coolant.

As stated above, directly cooled horizontal casting equipment for continuous casting of metal in which oil is supplied through the cavity wall through an annulus or a permeable wall element in order to form a lubricant film between the mould wall and the metal is already known.

Although this type of casting equipment functions reasonably well, the quality of the cast product is, however, much poorer than that of equivalent vertical casting equipment in which, in addition to oil, gas is also supplied through the cavity wall.

One of the disadvantages of vertical casting equipment is that it comprises a large number of moulds. This makes it expensive to produce.

Moreover, the vertical equipment is only designed to cast specific lengths in a semi-continuous process. This also makes it expensive to operate.

Casting with horizontal casting equipment involves the use of only a few moulds and the casting takes place continuously. Suitable lengths of the cast product are cut off during the casting operation. The continuous, horizontal casting equipment is thus both cheap to produce and cheap to operate.

One aim of the present invention was to produce horizontal equipment for continuous casting of metal, in particular aluminium, with which the quality of the cast product is as good as the quality of the equivalent cast product with vertical casting equipment.

The equipment in accordance with the present invention is characterised in that gas in addition to oil is supplied through the permeable wall material and that annuli are arranged between the permeable wall material and the mould housing to distribute the gas/oil to the wall material and that the annuli are divided into sectors using plugs and are supplied with oil/gas via separate supply channels for each sector, whereby the supply of oil/gas may be differentiated around the circumference of the mould cavity.

Claims 2-5 define the advantageous features of the present invention.

The present invention will be described in the following in further detail by way of examples and with reference to the attached drawings, where:

Fig. 1 shows, in part, in an elevation, the casting equipment for continuous horizontal casting of long objects, for example aluminium billets.

Fig. 2 shows, in large scale, the mould shown in Fig. 1, a) in cross-section and b) in a longitudinal section.

As Fig. 1 shows, the casting equipment 1 in accordance with the present invention comprises an insulated metal reservoir or pool 2 and a mould 3. The pool 2 is provided with a lateral opening 4 to the mould 3, where a connecting ring 5 of thermally insulating material forms the transition between the pool and the mould 3.

On its side, the mould is releasably attached to a holding device 6. Via a hinge link 7, it is possible to swing the holding device and thus the mould 3 from a position in which it is in contact with the connecting ring 5 to a swung-out position which makes it possible to remove (replace) or repair the mould.

The mould itself, which is shown in further detail in Fig. 2, comprises a two-part annular housing, of which a first main housing part 8 is provided with drilled holes 10,11 for the supply of oil or gas to interior, permeable cavity rings 12,13, while a

second housing part 9 is provided with an annular recess which forms a water cooling channel 14. The two housing parts 8 and 9 are held together by means of a number of screws 15. When they are screwed together, as shown in the figure, a diagonal gap 16 is formed between the two parts so that, during the casting operation, water flows from the channel 14 and through the gap 16 along the entire periphery of the cast product just outside the outlet of the cavity 17.

As mentioned, permeable rings 12, 13, which are physically separated from each other by a gasket, sealing material 18 or similar, are included. These rings form the wall in the cavity 17.

An important feature of the present invention is that the annuli 20 (see Fig. 2, b)) formed between the mould housing 8 and the rings 12,13 are provided with plugs 21 (only 2 shown in the drawing) so that the annuli 20 are broken up into two or more sectors as required. In this way, the supply of both gas and oil can be differentiated along the circumference of the cavity. Such differentiation, in particular of the gas supply, is important in order to be able to achieve a good casting result.

Supply of gas to the mould cavity of horizontal casting equipment is not previously known. To enable drainage of excess gas and thereby avoid inclusion of gas in the cast metal product under the casting process a bore 29 is provided through the mould wall (the ring 12). The gas is led to an annulus outside the ring 12 and further through a bore in the housing 8 (not further shown) to the atmosphere or a suitable collecting tank or the like for the gas.

At the inlet of the cavity 17, there is a plate 19 of thermally insulating material ("hot-top") which is held in place using a retaining ring 22 via a screw connection 23.

As the wall of the cavity 17, i.e. the rings 12, 13, forms the primary cooling area during the casting operation, the area of the wall surface will represent one of the factors which determine the cooling of the metal.

The insulating plate 19 may, depending on the type of alloy and the primary cooling required, extend along the ring 12 (at 24) somewhat.

As the plate can be easily detached, it will be easy to replace the plate and thus cast different types of alloy in the same mould.

Otherwise, the casting equipment in accordance with the present invention works as follows:

Liquid metal, for example aluminium, is poured into the pool 2 from a casting furnace or similar (not shown). The metal flows through the opening 4 and the holes 25, 26 in the plate 19 into the cavity 17.

At the beginning of the casting operation, the outlet 27 in the mould 3 is closed using a mobile casting shoe (not shown). As soon as the metal has filled the cavity 17, the shoe begins to move, while water is supplied through the gap 16 and gas and oil are supplied through the ring 12, 13.

As the casting shoe moves and the cavity is refilled with metal via the pool, a long casting piece is formed. The shoe is removed as soon as the casting piece has reached a certain length. Since the casting process is continuous, the casting piece may actually be of any length. However, it is expedient for the casting piece to be cut (not shown) into suitable lengths for extrusion or other purposes.

As mentioned above, the casting equipment is designed for differentiated supply of oil and gas around the circumference.

In particular regarding the supply of gas, it has been found expedient to supply the same quantity of gas around the entire circumference of the cavity at the start of the casting process. Subsequently, when the casting process has started and has become stable, the gas supply to the upper area of the cavity is reduced. Preferably, in this connection the annuli 20 for the supply of gas may be divided into two sectors, an upper and lower, by means of restrictions 21.

Moreover, regarding the primary cooling, i.e. the cooling through the rings 12, 13 in the cavity 17, it has been found expedient, in order to reduce the cooling, to make the mould housing 8 of steel instead of aluminium, which is the usual material. Furthermore, in order to reduce the cooling further, it may be necessary to shield (reduce the thermal transfer to) the cooling channel 14 by arranging an insulating annular plate 28, for example of Plexiglas, on the side of the housing part which faces the cooling channel.

The invention as defined in the claims is not restricted to the embodiments shown in the drawings and described above, thus, instead of using two independent rings 12,13 just one ring may be employed for the supply of oil and gas through the same ring.

Claims

1. Equipment for continuous, horizontal casting of metal, in particular aluminium, the equipment including an insulated reservoir or pool (2), which is designed to contain liquid metal, and a mould (3), which can be removed from the pool (2), with an insulating plate (19) with holes (25, 26) which communicate with the mould, the mould (3) including a preferably circular cavity (17) with a wall (12, 13) of permeable material for the supply of oil and at least one annular slit or nozzles (16) arranged along the circumference of the cavity for the direct supply of coolant,

c h a r a c t e r i s e d i n that in addition to the oil gas is supplied through the permeable material (12,13) and that annuli (20) are arranged between the permeable wall material and the mould housing (8) to distribute the gas/oil to the wall material where the annuli (20) is divided into sectors using plugs or similar restrictions (21) and are supplied with oil/gas via separate supply channels (10, 11) for each sector, thus making it possible to differentiate the supply of oil/gas around the circumference.

2. Equipment in accordance with claim 1,

c h a r a c t e r i s e d i n that the wall material comprises two rings (10, 11) which are physically separated by means of a gasket (18) or similar.

3. Equipment in accordance with claim 1,

c h a r a c t e r i s e d i n that each of the annuli (20) are split into two sectors, and upper and lower sector.

4. Equipment in accordance with the preceding claims 1-3,

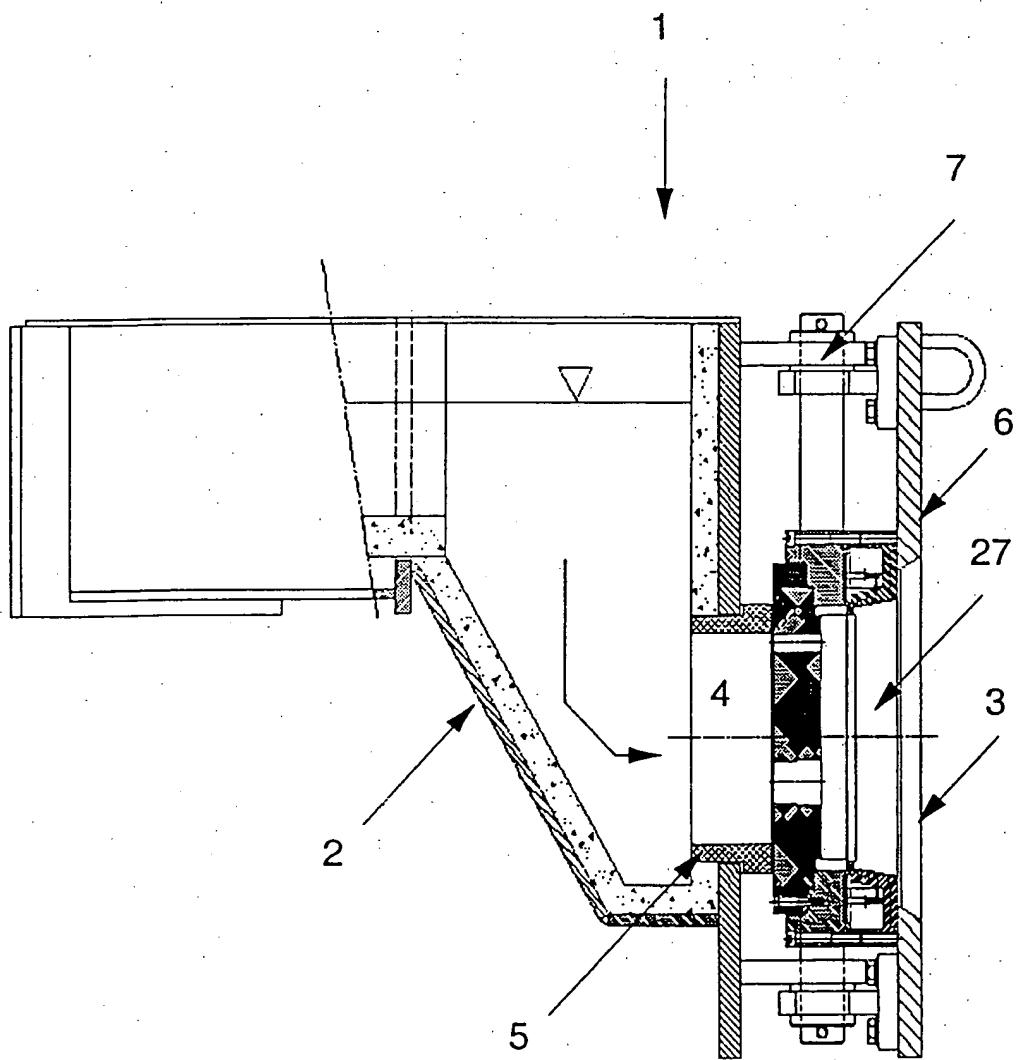
c h a r a c t e r i s e d i n that the gas is supplied through the permeable material (through 12) in the area closer to the plate 19, while the oil is supplied through the material in the area further from (through 11) the plate (19).

5. Equipment in accordance with the preceding claims 1-4,

c h a r a c t e r i s e d i n that a drainage bore or channel (29) is provided in the upper part of the mould cavity to drain out excess gas.

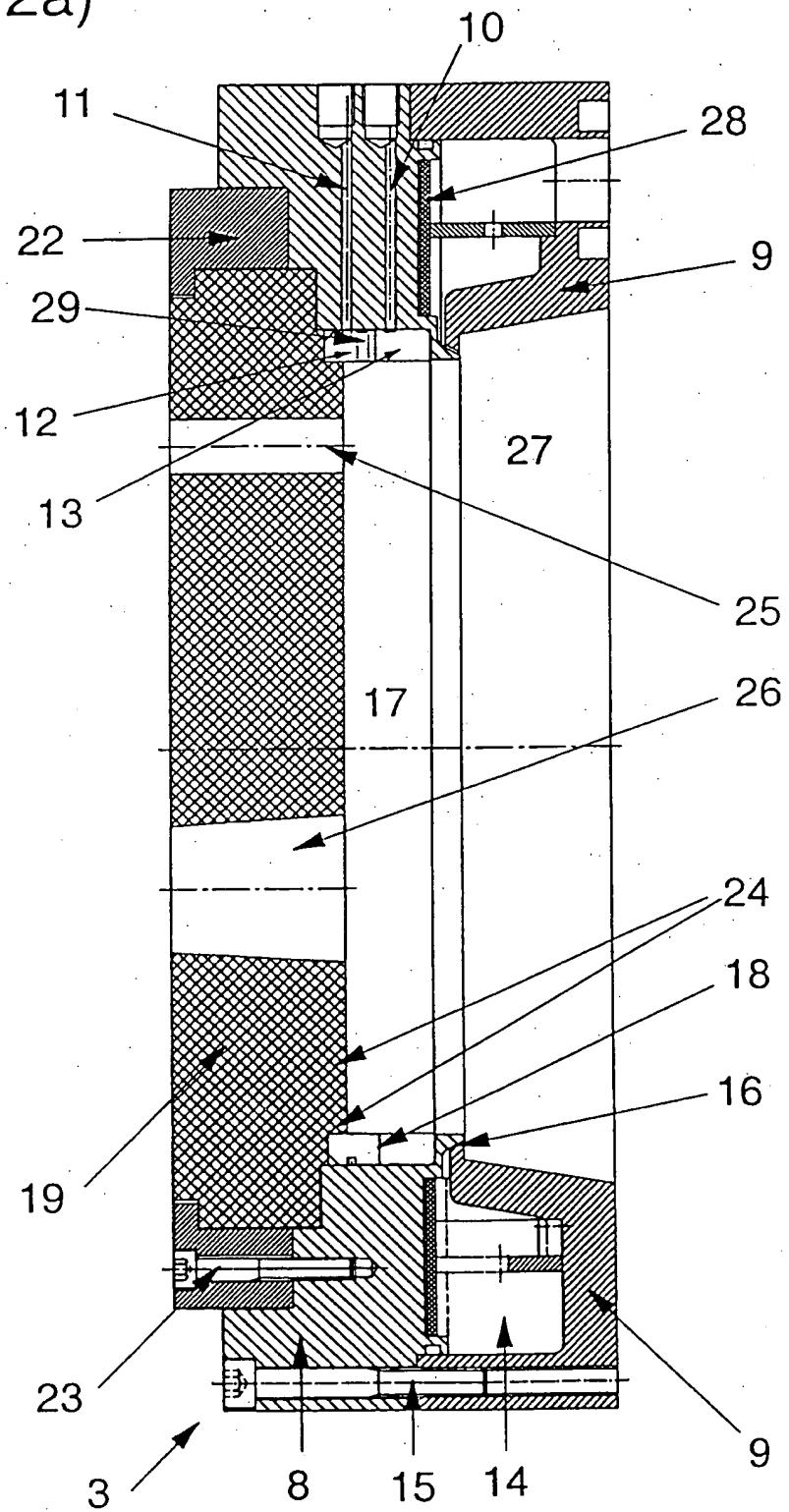
1/3

Fig. 1



2/3

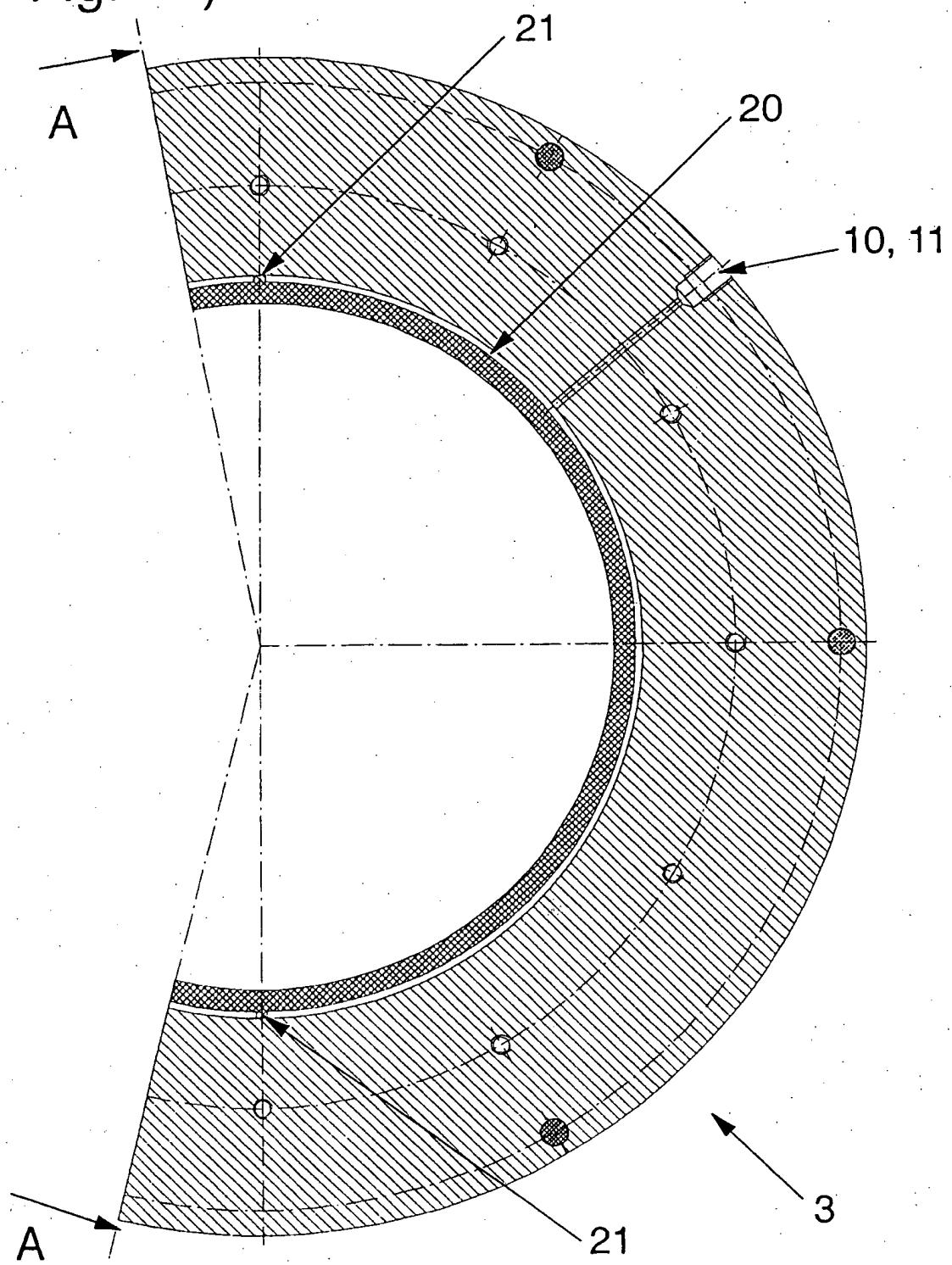
Fig. 2a)



Section A-A

3/3

Fig. 2b)



INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 00/00221

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B22D 11/04, B22D 11/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	NO 302804 B (NORSK HYDRO ASA), 27 April 1998 (27.04.98), page 3, line 14 - page 5, line 12, figure 2, abstract --	1-5
Y	US 3556197 A (J.J. FOYE), 19 January 1971 (19.01.71), column 1, line 10 - line 70, claims 1-7, figures --	1-5
A	US 2690600 A (B. TARMANN ET AL), 5 October 1954 (05.10.54), figure 2, claim 1 --	1-5

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "P" document published prior to the international filing date but later than the priority date claimed
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- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

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Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86Authorized officer
Ulf Nyström / MRo
Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4688624 A (K. SUZUKI ET AL), 25 August 1987 (25.08.87), column 6, line 1 - column 7, line 7, figures 4-6	1-5

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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